"Readiness through Knowledge"

Headquarters Air Weather Service

Aerospace Sciences Division

Providing Service Worldwide

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June 1996

Number 30

Barnes Analysis

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In your weather training, you've spent time learning how to hand plot and analyze surface and upper air charts. Some of that time-consuming, often tedious work, was lessened with the addition of the Automated Weather Distribution System (AWDS) and its Formatted Binary Data (FBD). Even with AWDS, however, the automated analysis charts still required a manual adjustment (reanalysis), so contour positions best matched the observations from FBD plots.

With AWDS 3.2, the software routine that automatically analyzes the data is greatly improved in both speed and accuracy. You can now use a new Objective Analysis (OA) program called Barnes Analysis. This series of OA programs provides a better and more accurate match of contours to FBD observations than in the past. We say a "series of programs" because Barnes OA is composed of many different types of analysis options—almost all are operator selectable! You can pick and choose which type(s) of analysis program to use for any particular data set. The bottom line is that YOU control which type of OA program AWDS will use to generate products!

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BARNES OBJECTIVE ANALYSIS

By
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INTRODUCTION

In your weather training, you've spent time learning how to hand plot and analyze surface and upper air charts. Some of that time-consuming, often tedious work, was lessened with the addition of the Automated Weather Distribution System (AWDS) and its Formatted Binary Data (FBD). Even with AWDS, however, the automated analysis charts still required a manual adjustment (reanalysis), so contour positions best matched the observations from FBD plots.

With AWDS 3.2, the software routine that automatically analyzes the data is greatly improved in both speed and accuracy. You can now use a new Objective Analysis (OA) program called Barnes Analysis. This series of OA programs provides a better and more accurate match of contours to FBD observations than in the past. We say a "series of programs" because Barnes OA is composed of many different types of analysis options—*almost all are operator selectable*! You can pick and choose which type(s) of analysis program to use for any particular data set. The bottom line is that YOU control which type of OA program AWDS will use to generate products!

There's a lot of new information to digest when learning about Barnes OA techniques on AWDS. It may seem overwhelming at first that so many different options are available when you generate a contour product on AWDS. Our goal in this publication is to present an overview on the concepts and basic use of the new Barnes OA. It's a way to get you started using the new Barnes techniques and to hopefully make you feel comfortable in using this improved AWDS capability.

"...YOU CONTROL WHICH TYPE OF OA PROGRAM AWDS WILL USE TO GENERATE PRODUCTS!"

Discussion

Knowing how to select Barnes options from AWDS and to understand the "science" behind Barnes concepts are important information for all forecasters to know. Because of their complexity, we've broken down our discussion of Barnes OA in this T-TWOS into three sections: Objective Analysis Grids, Operational Use of Barnes, and Barnes In Depth.

The first section discusses how computers, specifically AWDS, use OA techniques to create grids from FBD observations. AWDS then uses these grids to construct isoplethed and streamlined products.

Section two concentrates on the operational aspects of Barnes OA. This section steps you through menus and menu selection options available at the workstation. Within the text, bulleted items on menu selections will show you the order of the commands used to arrive at the example screens. This section also includes a recommendation listing and a simple matrix that describes some basic strengths and weaknesses of the different Barnes options and/or combinations of settings.

The last section will focus on the science of understanding Barnes. It includes in-depth explanations of specific Barnes selection options and routines, as well as some additional background material. We'll discuss Barnes analysis techniques in more of an abstract, and in less of a meteorological way. This section is intended to be a reference guide to use to answer questions on any one particular aspect of the Barnes process.

Objective Analysis Grids

Unlike humans, computers don't plot observations and then immediately draw lines to the data. Computers can only draw contours from an equally spaced set of points called a "grid." Each time you request AWDS to isopleth or streamline from FBD plots, the first step accomplished by the OA software is to construct a grid from FBD plot information.

The intermediate step of constructing a grid for use in the production of the final product is nothing new to AWDS software. AWDS has always used an OA program, but most people just didn't know what it was, or how it was used. In the past, the grid created by AWDS was invisible to you--something that just happened in the background. Since the technique was built into the software, and not operator selectable, there was not a great deal of effort placed in understanding its inner workings.

Grids created through the OA process are called Locally Generated Grids (LGGs). This term should sound very familiar to you! You've hopefully created and used LGGs on AWDS in the past. This LGG grid is the essential ingredient needed by the Barnes analysis program in order to calculate and create the contours of the final product.

Operational Use of Barnes

Barnes Options

There are multiple combinations of Barnes techniques options available using AWDS. As you begin the process of deciding which combination(s) are the best for your unit, here are some descriptions of the two basic types; system hard wired, and operator selectable.

System Hard Wired. There are a couple of easy-to-use "prepackaged" Barnes options that might be useful in getting you started. They are system hard wired into AWDS and called the *Quick Method* option and the *Barnes Defaults* option.

The *Quick Method* option is the least sophisticated of all the options available on Barnes, but it's also the fastest. *Using Barnes Defaults* lets you use some of the capability of Barnes without having to physically adjust individual technique parameters.

Figure 1 below shows menu examples of where Quick Method and Barnes Defaults can be located and selected.

- GENERATE COMPONENT
- Isopleth with Raw Data, Streamline with Raw Data, or LGG with Raw Data
- Toggle to FBD DATA
- Toggle to Quick Method or Barnes Default

We recommend using the Barnes hard-wired options only as an interim solution or if a situation arises where selecting individual parameters is impractical.

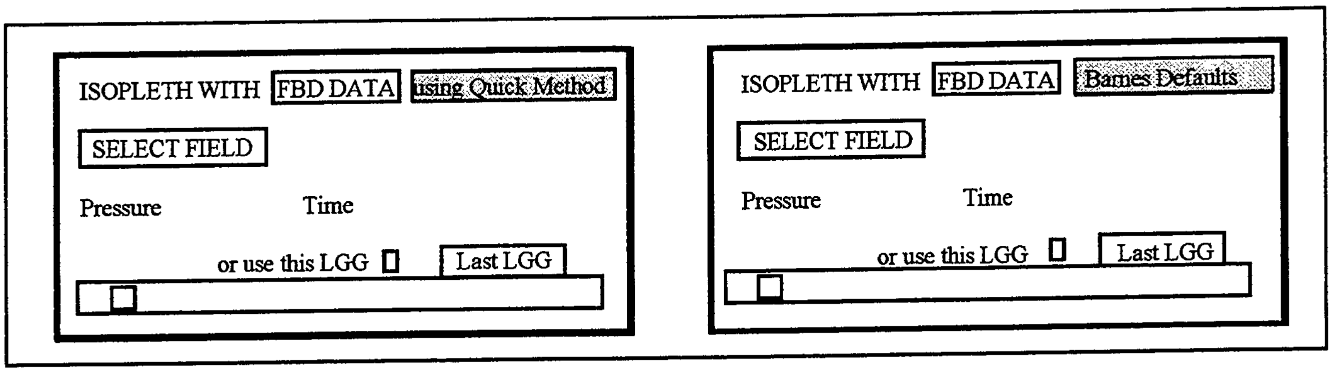


Figure 1.
Barnes Options (System Hard Wired) Menus

Operator Selectable. By far the most flexible and powerful Barnes options available on AWDS 3.2 are the operator-selectable OA techniques. You can access all of the different combinations easily through the *Set/View Options* selection found beneath the *FBD Data, Using Barnes* toggle icon, see Figure 2.

- GENERATE COMPONENT
- ISOPLETH with Raw Data, STREAMLINE with Raw Data, or LGG with Raw Data
- Toggle to FBD DATA
- Toggle to using Barnes

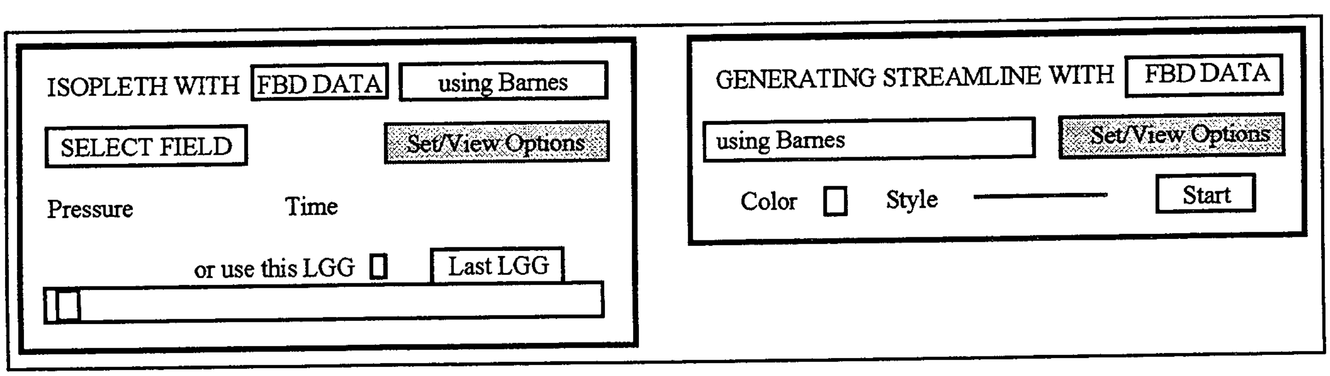


Figure 2.
Barnes Options (Operator Selectable) Menus

Using the Barnes Set/View Options Menu

The Barnes SET/VIEW OPTIONS menu is where we actually pick which Barnes OA technique AWDS will use in order to construct the grid and eventually display an end product. Don't forget, all of the choices for selecting which OA process AWDS will use is completely up to you! In Figure 3, you'll see the three possible on-screen menus that could appear after selecting the SET/VIEW OPTIONS menu.

The particular screen that you'll see from Figure 3 will depend on which first-guess option was previously selected. By this we mean that the screen, and its selected parameters, will remain resident in the background unless the menu is physically changed. AWDS will use these parameters for all computations. To exit the SET/VIEW BARNES OPTIONS screen (either after changing a selection or accepting the current selection), click on PRIOR PANEL. This will return you back to the previous screen.

- GENERATE COMPONENT
- ISOPLETH with Raw Data, STREAMLINE with Raw Data, or LGG with Raw Data
- Toggle to FBD DATA
- Toggle to using Barnes
- SET/VIEW OPTIONS

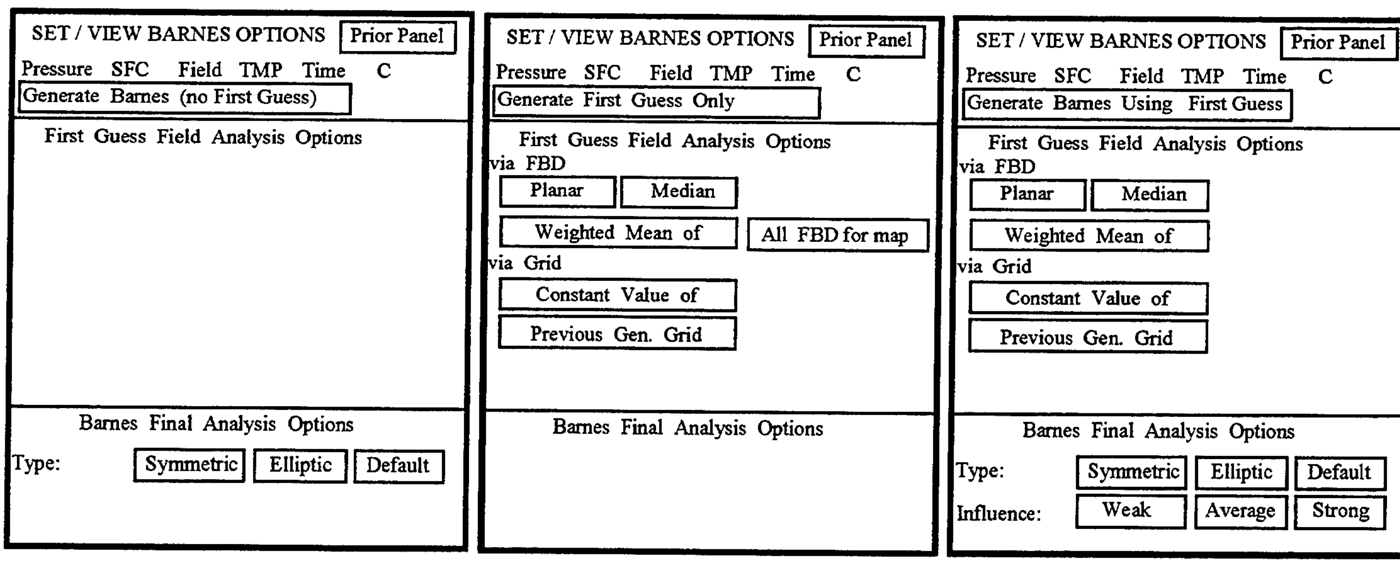


Figure 3.
Barnes Analysis Option Panels

First-Guess Options. The technique that's chosen as the first-guess grid option is one of the most important selections in the entire Barnes OA process. Each first-guess grid option has a specific subset of selectable parameters available; in fact, some options are available ONLY with specific first-guess options!

The selectable first-guess options are:

- *Generate Barnes (no First Guess)*
- *Generate First Guess Only*
- *Generate Barnes Using First Guess*

Generate Barnes (no First-Guess). This option is used when you want to generate a grid without using first-guess results. (See Figure 4)

- Software decides which type(s) of analysis defaults to use.
- Limits the selectable analysis parameters to only *Type* of area.
- Use technique with discretion.

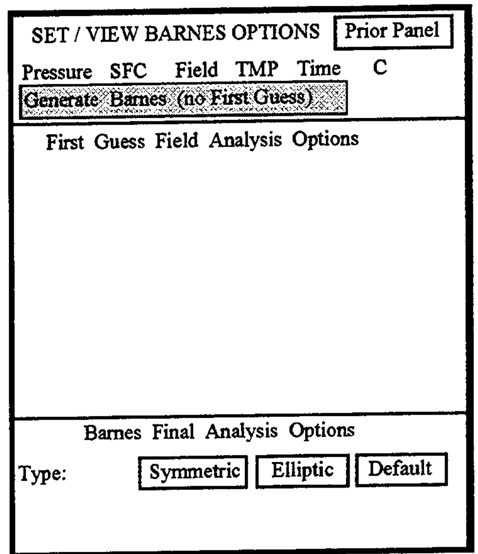


Figure 4. No First-Guess

Generate First-Guess Only. This option is used when you want to generate a grid without using Barnes Final Analysis Options. (See Figure 5)

- Allows you to choose which first-guess analysis is used.
- Uses Gaussian, not linear weighting (see upcoming section).
- Least recommended technique.

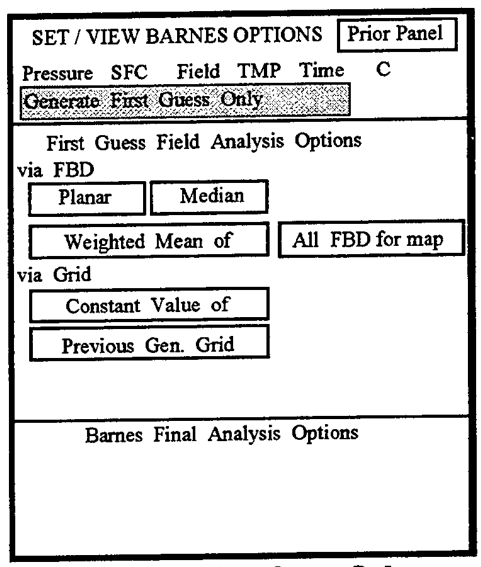


Figure 5. First-Guess Only

Generate Barnes Using First-Guess. This option is used when you choose the first-guess method and subsequent analysis options. (See Figure 6)

- All advanced Barnes options are available.
- Provides the most detailed and comprehensive analysis.
- Recommended analysis option.

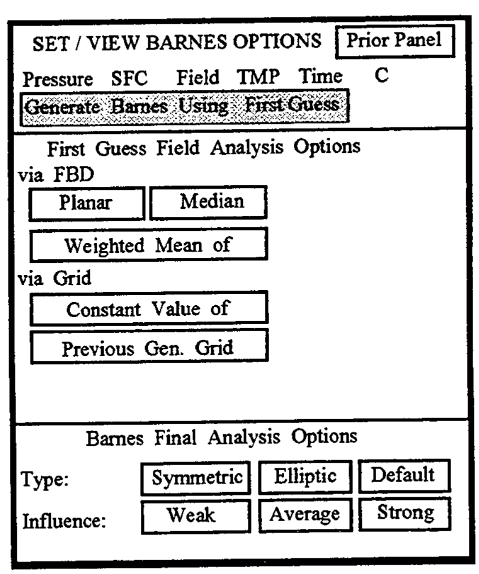


Figure 6. Using First-Guess

Making Your Selections

You may be asking yourself, "Which combination(s) of these selections will work best at my unit or in my geographical region?" In this section, we'll provide some operational tips and software strengths/weaknesses up front that should guide you to what works best. It needs to be said, however, that most of our suggestions are system and software based—not meteorologically based.

This means AWDS users will shoulder the responsibility to experiment, document, and crossfeed the results of using the different Barnes techniques. Which combination works best for coastal units? Which combination does the best job of analyzing specific parameters (TMP, GPH, etc.)? Be patient, test the software, and be aggressive to help us to figure out the answers.

Barnes Recommendations. The following list and accompanying matrix (Figure 7) outlines most of what we currently know about the strengths and weaknesses of Barnes OA. Again, you'll notice that only a limited number of the tips and hints address recommendations from a meteorological point of view. The recommendations include:

- If time is a consideration, the *Quick Method* is always faster than other Barnes techniques.
- If quality is a consideration, try a comparison between the *Quick Method* and the Barnes techniques within your area of interest. Most likely you'll find that the *Quick Method* is often as good as the most advanced Barnes technique if you're in a data-rich environment. The time/quality trade off for using Barnes techniques works best in data-sparse areas.
- If the data set you are using has large data-sparse areas, the *Median* first-guess development option may not work. This is particularly bad because *Median* is the first-guess option of *Barnes Default*.
- Use *Median* when a strong gradient exists for the meteorological parameter requested, i.e., temperature.
- Be careful with command sequences using *Default*; you may have to program Forced Prompt delays within your sequences in order to load previously generated grids.
- As an operator, consider using *Weighted Mean Of* as the first-guess option within your command sequences; it works every time.
- Using the *Weighted Mean Of* option dampens the effect of data clustering. When you have a very large amount of FBD observations within a small area, their cumulative effect can degrade the analysis. Using the *Weighted Mean Of* (because it uses the average of all FBD observations) has the ability to lessen the result of clustered FBD.
- Always consider using a *Previously Generated Grid* (LGG, UGDF, etc.) as your first-guess option, especially if you are in a data-sparse area. This will allow AWDS to start every grid point with a reasonable number.
- When using a *Previously Generated Grid* as a first-guess grid, try and match the valid times the best you can. You may have to use a forecast grid if your analysis is between model "runs."
- If using UGDF grids as your *Previously Generated Grid*, remember to use the 1000 or 925 mb heights for surface analyses.
- Use *Planar* when there is a systematic change across the data. For example, temperatures generally decrease from south to north, so using the *Planar* option for temperature would have that systematic change.
- The *Planar* first-guess option is thus far been found to be the least accurate of the first-guess development options.

BARNES OBJECTIVE ANALYSIS

	STRENGTHS	WEAKNESSES
QUICK METHOD (QM)	- Fastest option available on AWDS - Best in data-rich areas - Works with ANY data coverage	- Uses unsophisticated equations - Data on borders become "Spider Web-Like" - Data on interiors look "pie shaped"
MODIFIED BARNES		
TECHNIQUE OPTIONS		
No First-Guess	- Software decides which techniques to use	- Not the best Barnes technique
First-Guess Only	- Using Gaussian, not linear weighting	- Not a recommended technique
Using First-Guess	- The most options available - Provides most detailed analysis	- Takes longest time to run
FINAL ANALYSIS		
Median	- Use in areas of strong gradients	- May not work in data-sparse areas
Planer	- Best for systematic changes over area	- Least accurate first-guess method
Weighted Mean Of	- Dampens the effect of data clustering	- Uses average of entire grid as first-guess
Constant Value Of		- Depends on operator to input values
Previous Grid	- Best first-guess grid available	
Symmetric	- Use for surface (light winds)	
Elliptic	- Use for upper air (stronger winds)	
Weak	- Data-sparse areas	
Strong	- Data-dense areas	

Figure 7. Strengths and Weaknesses of AWDS 3.2 Objective Analysis

Barnes In Depth

Comparison Of Analysis Methods

As previously mentioned, AWDS has always used an OA program to create a grid. The kind of programs you access is dependent on which version of AWDS you have installed, and in the case of AWDS 3.2, which Barnes package is resident on your system.

AWDS 3.1. The Nearest Neighbor technique is the only OA option available on AWDS 3.1. The program assigns grid point values from the closest FBD observation. Each FBD observation can supply a value for only one grid position. So all other grid values not initially assigned a value must be interpolated by the OA program from a nearby observation.

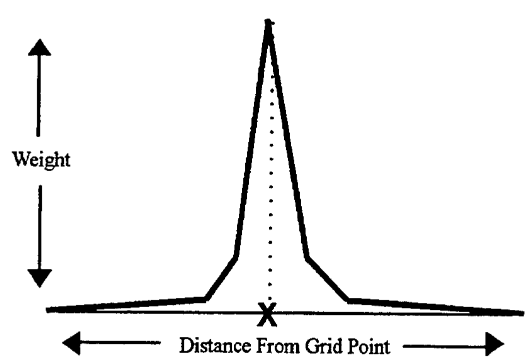
The Nearest Neighbor technique uses a *linear weighted average* to interpolate and assign values for the remaining grid points. A linear weighted average takes FBD observation values from over a selected area, and based on its distance from the grid point, assigns a weight. For example, an observation 200 miles from the grid point would carry 1/2 the weight that an observation 100 miles away would --a true linear computation.

This technique is very fast and works very well in data-rich areas. However, it does have its weaknesses. Everyone is familiar with the "spider web-like" appearance of a chart over oceans and other data-void areas using FBD. Because of using the Nearest Neighbor technique in the formation of the grid, the contours are not representative of the actual conditions.

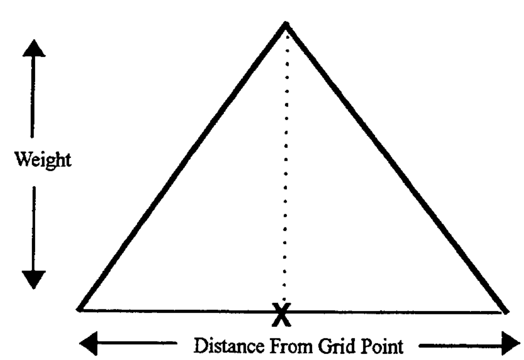
AWDS 3.2. Using AWDS 3.2, you will have some additional choices for your FBD analysis that does a better job at combatting the weaknesses of Nearest Neighbor. A modified version of the Nearest Neighbor technique is still around in AWDS 3.2 but it's now called Quick Method. Upon installation of AWDS version 3.2, besides the Quick Method, you will also be able to use a a variety of advanced Barnes techniques.

The Barnes techniques consist of a variety of options--most of which are user-selectable. Instead of using a linear-weighted average, the Barnes techniques uses a Gaussian weighting function, or a combination of both Linear and Gaussian. In everyday terms, the Gaussian weighting function still gives greater weight to those observations that are closer to the grid point (similar to Linear weighting), but how they are weighted is very different.

The Gaussian weighting for an observation employs an exponential decrease in weighting the further away you move from a grid point position. For example, an FBD observation 50 miles away from the grid point might be weighted six times (6X) more than an observation 150 miles away--and twenty times (20X) greater than an observation at 300 miles! Figure 8 shows examples of both Gaussian and Linear weighting.



Gaussian Weighting



Linear Weighted Average

Figure 8.
Examples of Gaussian and Linear Weighting

It all sounds somewhat complicated, but when broken down into its various steps, the processes become clearer. Just remember that there are basically three steps in the Barnes process that give AWDS instructions on how to construct the grid:

- Set the analysis option of your choice (SET/ VIEW BARNES OPTIONS).
- Pick a first-guess routine (FIRST-GUESS FIELD ANALYSIS OPTIONS).
- Select a "fine-tuning" method (BARNES FINAL ANALYSIS OPTION).

Set/View Barnes Options

Step One in the Barnes OA process is to select the path that AWDS will take in making a grid. You aren't really selecting the actual technique used in the creation of the first-guess grid, that comes in Step Two. The selection you make here is whether or not to use some or all of the Barnes capability, and the ability to select your own technique options. The menu choices are:

- *Using Quick Method*
- *Using Barnes Generate Barnes (no First Guess)*
- *Generate First Guess Only*
- *Generate Barnes Using First Guess*
- *Barnes Defaults*

Using Quick Method. When this option is selected, the system will use the Quick Method as the basis for constructing the grid. This OA technique is a hybrid of the AWDS Nearest Neighbor technique. It is very fast on the Sparc Workstations, but its final analysis is smoothed and could potentially be inaccurate when compared to known FBD plots.

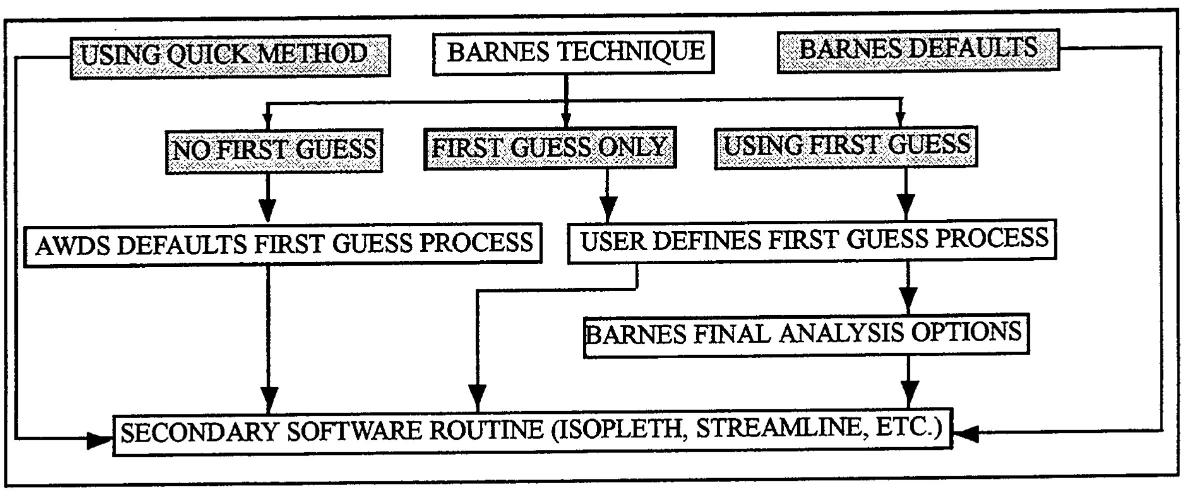


Figure 9.
Analysis Options

Generate Barnes (no First Guess). When picking this choice, AWDS creates a first-guess grid by only evaluating FBD observations. There isn't an intermediate smoothing of the data as in other techniques. The only secondary type of processing in this option is for *Type* of Area. This selection is the fastest of the Barnes options, but not always the best analysis technique.

Generate First Guess Only. When choosing *Generate First Guess Only*, you are using the Gaussian method to construct the first-guess grid, but the process doesn't continue into using any Barnes fine tuning options. This option works best when you are creating a grid from a data-rich area where the first-guess grid is very reliable.

Generate Barnes Using First Guess. This is the most sophisticated and powerful of all the options presented. It allows you to use all of the Barnes options and all the operator-selectable parameters (first-guess options and final analysis options).

Barnes Default. If you choose this option, AWDS will default to a list of pre-specified option selections: *Generate Barnes Using First Guess*, FBD as source, *Median* for first-guess field, strong FBD *Influence*, and either symmetric for surface or elliptic for upper air (default setting). All of these options are discussed in the following paragraphs.

Figure 9 (page 9) shows a flowchart from the Barnes Options described above.

Analysis Options

There are a variety of first-guess options to choose from. The list includes:

- *Median*
- *Planar*
- *Weighted Mean Of*
- *Constant Value Of*
- *Previously Generated Grid*

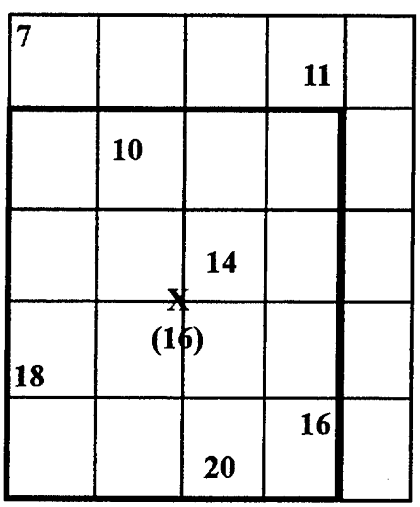
The first three options (*Median*, *Planar*, and *Weighted Mean Of*) all use FBD information as the input data for making the initial first-guess. The last two options (*Constant Value* and *Previously Generated Grid*) use a gridded field as the original data input field for the first-guess. Below is a list and an explanation of each first-guess option:

***Median* (FBD)**. When you select the *Median* option to get a first-guess grid, the program begins by searching for FBD observations in an area bounded by two grid points in all directions from the grid point. This region covers an area of 16 grid squares (see Figure 10).

To provide a value to the grid point, there must be *at least three* FBD observations within the defined grid boundary. If three or more FBD observations are found, the *Median* technique simply chooses the middle value (not the average, but the middle) of the group and applies that value to the grid point location. If at least three observations are not found, the OA program will search the area by adding two additional grid squares in each direction.

If AWDS doesn't find the required FBD values, it continues to increase its search size by an additional two grid points. It does this until the search size goes beyond half of the entire grid without success. It will then automatically discontinue the program. At this point, AWDS provides a message indicating the request cannot be completed.

The numbers in Figure 10 are values for specific FBD meteorological parameters (TMP, PPP, GPH, etc.). The "X" is the location of the grid point we are trying to find a value for. In our example, the observa-



FBD: 10, 14, 18, 16, 20

[Order Numerically: 10, 14, 16, 18, 20]

[Select Middle Value (Median): 16]

Grid Value = 16

Figure 10.
Median Option

tion values of 10, 20, 16, 14, and 18 all lay within the two-grid space boundary (dark outline). The program will assign the grid point a value in this example because there were three or more FBD observations found within the boundary. The values are rank ordered (lowest to highest) and the middle value is chosen as the grid value.

***Planar* (FBD)**. This option uses a 2-Dimensional (2-D) flat plane, placed into a 3-Dimensional (3-D) field of FBD observations. The program positions the plane so that it represents the "best possible fit" for the data--that is, the most representative position for all observation values within that field.

A few FBD points may correspond exactly to the assigned value on the plane. There will be many FBD observation points found both above and below the plane. The grid point values in the first-guess field don't reflect exact values of the observation points except for those FBD values that were originally located on-plane. This method will give the best results when there is a systematic change in the parameter over distance (i.e., temperature and geopotential heights).

The FBD field in Figure 11 uses a 500 mb Geopotential Heights (GPH) example. There is a systematic increase in GPH values as we move from the bottom to the top of the diagram. Notice how some of the actual observation values fall both above and below the plane, with a small amount falling on-plane, as previously described. The values that are used on the first-guess grid come from where the plane aligns with the height levels that are found up the left side of the diagram.

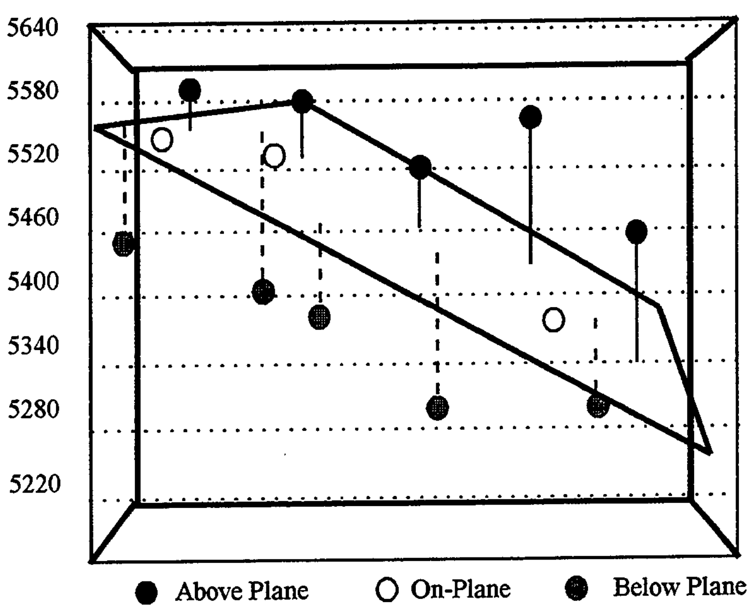
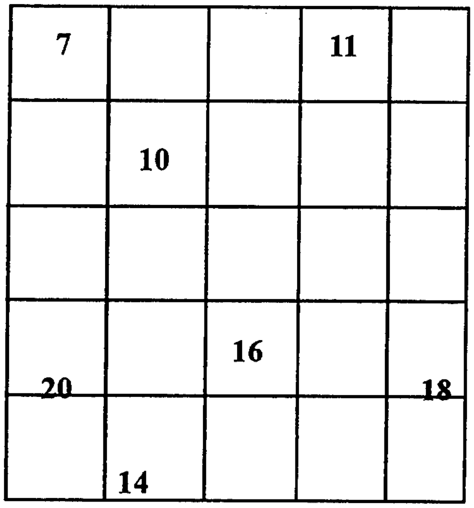


Figure 11.
Planar Options

***Weighted Mean Of* (FBD)**. With the *Weighted Mean Of* first-guess option, each grid point in the first-guess field receives the same value. This option will *always* work, even if the analysis is done in data-void regions.

In developing a first-guess field using the *Weighted Mean Of* option, AWDS is simply looking at *every* observation value on the PI Set and determining the average value of all the data. Unlike the *Median* option, this process uses an actual mathematical average of all observations and applies that value to all grid points. Figure 12 shows an example of the *Weighted Mean Of* option with a grid point calculation of 13.7.



FBD: 7, 10, 11, 14, 16, 18, 20

[7 + 10 + 11 + 14 + 16 + 18 + 20 = 96]

[96 divided by 7 = 13.7]

EVERY GRID POINT VALUE = 13.7

Figure 12.
Weighted Mean Of Option

***Constant Value* (Grid).** This is the first option we've discussed that uses a gridded field instead of FBD observations in the calculation of the first-guess field. When you select *Constant Value*, AWDS will prompt you to enter a value. AWDS will not help pick a reasonable or correct value--that will be up to your judgement. You must know the approximate values of the data set and valid time that you are analyzing to get the best possible first-guess grid. That value entered will be used as the first-guess entry for ALL grid points.

So, for example, if you type in 12 when trying to build a first-guess temperature grid, AWDS will set all grid points to 12. Adjustment of the first-guess grid when using *Constant Value* can be very dramatic and not always give you reliable information on the extreme (high or low) ends of the data field.

***Previously Generated Grid* (Grid).** This option allows you to select a grid that already exists in the database to use as the first-guess grid. You can use the last LGG stored in the system, or you can select any other available grid and make it your first guess. This is a powerful option that when done correctly, can give you the BEST final analysis.

Barnes Final Analysis Options

We briefly touched on these final analysis options in the last section. Here they will be explored in greater detail. Both of these options are subroutines within the Barnes process. They are *Type of Area*, and the amount of FBD *Influence* the observations exert on the grid.

These choices refer to the way AWDS includes the surrounding observations for each and every grid point during the Barnes process. Figure 13 is how these options appear on the SET/VIEW BARNES OPTIONS screen:

Barnes Final Analysis Options			
Type:	Symmetric	Elliptic	Default
Influence:	Weak	Average	Strong

Figure 13.
Example of Type and Influence On Barnes Final Analysis

Type of Area

Symmetric. The *Symmetric* technique will search in a perfect circle away from every grid point to determine the weight applied to FBD observations. When using symmetric, every observation located the same distance away from the grid point is assigned an identical weight. It is designed for use with a scenario of light winds, where no correction for high winds is needed. This option is recommended when doing an FBD surface analysis or for using the very lowest layers (1000 and 925 mb, for example) of an upper air analysis.

In Figure 14 below, the weighting that is given to points A, B, and C are equal. All points the same distance from the grid point center and within the area of influence are weighted the same.

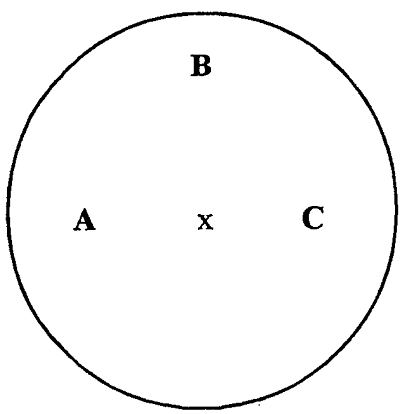


Figure 14.
Example of Symmetric *Type of Area*

Elliptic. The *Elliptic* technique tells the Barnes software to weight FBD observation data in a special way using the prevailing wind direction as a guide. The elliptic technique gives more influence to data both in the upstream and downstream directions. Data outside the established area of influence are given less weight. The mathematics involved in the Barnes process will automatically detect the wind "direction" and orient, size, and shape of the ellipse accordingly for each grid position.

Notice how the ellipse in Figure 15 is elliptical shaped along an axis formed by the prevailing wind direction. Observations at points A, B, and C are located an equal distance from the grid point but are weighed differently. In this example, values from points A and C are within the elliptical area of influence and will have more weight in the calculation of the final grid point than the value at point B. All FBD observation along the axis (such as points A and C in our example) are weighted the same with respect to distance.

It is recommended to use the elliptic *Type of Area* whenever you do an upper-air analysis above 925 mb or whenever any analysis appears to be dominated by strong winds.

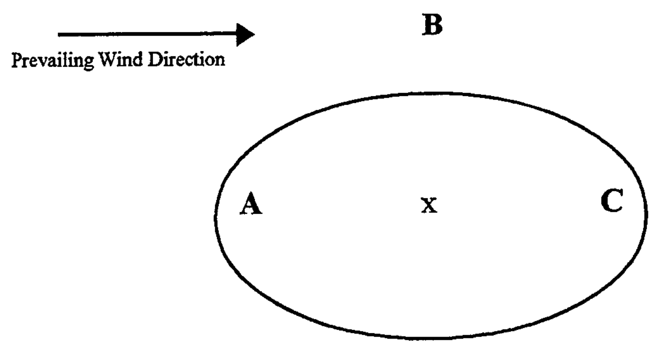


Figure 15.
Example of Elliptic *Type of Area*

Default. This is the third and last selection option available under *Type of Area*. When you select *Default*, the software will automatically use symmetrical for ALL surface requests and elliptical for ALL upper air requests.

As mentioned before, you may or may not want to use elliptical for all upper air (especially in the boundary layer). In data-rich areas using the *Default* all of the time shouldn't make any dramatic difference to the final grid. In data-sparse areas, however, having the operator select the best option manually may create a more representative final grid.

FBD *Influence*

Within the Barnes math equations is a place that defines how much influence FBD observations have on the "fine-tuning" of grid points--this is *FBD Influence*. The technique is used to correct poor first-guess grids, especially in data-rich areas. The available options include: *Weak, Average,* and *Strong*.

This influence is actually an exponential function. *Strong* has an exponentially higher influence as compared to *Weak,* and also to *Average*. This means that *Strong* allows more influence than *Average*, and much more influence than W*eak*.

Weak. Opposite of what you might think, using *Weak* is recommended when the amount of data within a PI Set is sparse. This is because you don't want a handful of FBD stations to overinfluence (skew) the first-guess grid and produce an inaccurate or an inappropriate analysis.

Average and ***Strong***. Using *Average* and *Strong* as the influence are less clear cut. Average is used when the data amount/coverage in an area is either not known or not clear-cut (sparse or rich). We recommend using the *Strong* option when an area is data-rich in coverage.

In reality, most grids created in data-rich areas WILL NOT show major differences regardless of the option you select for FBD influence.

☑ CONCLUSION

As you step through the option process and use the hints and tips that are provided as a road map--be creative! As with most other new and powerful capabilities on AWDS, your imagination and enthusiasm in using it will determine its success or failure on the counter. Give Barnes a chance--don't just blindly use Barnes Defaults or continue to use the Quick Method as a standard procedure.

The best way to understand Barnes OA is to experiment with the different options, examine products from each, and compare the analysis result with true FBD observation values. Since the goal of Barnes analysis is to produce an analysis as close as possible to "hand drawn," this comparison at the FBD level is essential to document what is best for your specific operation and location.

Don't forget there really isn't one ideal analysis technique. What works best will vary with the meteorological parameter used, amount of data received for any particular valid time, and a host of other variables. Just have patience, it won't take long before you are very familiar and comfortable with all the selections on Advanced Barnes.

You can get help in locating scientific references from:

AWS Technical Library
859 Buchanan Street
Scott AFB IL 62225-5118
DSN 576-2625

☑ BIBLIOGRAPHY

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Chisholm, D. A. and Muench, H. S., *Aviation Weather Forecasts Based on Advection: Experiments Using Modified Initial Conditions and Improved Analyses*, Air Force Geophysics Laboratory, AFGL-TR-85-0011, January 1985.

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